Procuring Load Curtailment for Grid Security in Alberta

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Abstract:

ESBI Alberta Ltd. (EAL) is Alberta's independent Transmission Administrator (TA) and is responsible for the procurement of System Support Services also known as Ancillary Services.

This presentation looks at procurement of system load as an ancillary service that can be curtailed by a system dispatcher or tripped using protective relaying. The Alberta electric system has approximately 9000 MW of generation of which 7500 MW is used to satisfy system demand and the remainder is used to serve 'behind the fence' load that is not directly served by the Alberta transmission system.

Alberta has five types of services that loads can offer into, where the load is used to provide system security or assure adequacy of supply to customers in Alberta. Power systems have historically treated load with the 'Obligation to Serve' mindset and as we move into more competitive environments, some loads now have the mindset of 'Opportunity to Provide' ancillary and energy services.

Discussion:

Alberta, over the past few years, has developed programs, tariffs and ancillary services where system loads can participate.

1. Load Curtailment Program where loads can offer to curtail energy at a price. (Power Pool of Alberta)
2. Demand Opportunity Service tariff (TA)
3. Supplemental Operating Reserves provided from loads (TA)
4. Load tripping at 59.5 Hz for supplemental frequency regulation. (TA)
5. Interruptible Load RAS as supplemental frequency regulation triggered by teleprotection on 3-pole trip of 500kV interconnection. (TA).

The TA has designed rates for each of these services which are approved by the regulator.

Load Curtailment Program

Over the past few years Alberta has experienced load growth at a rate faster than the increase in energy supply. Many of the loads in Alberta did not wish to participate in the energy market to be dispatched on and off (or up and down) based on price. Some of the industrial loads, given enough lead-time, could curtail energy to help 'keep the lights on'. These industrial loads required 1 hour or longer notice before they can be curtailed and the loads provide the maximum amount of time that the load could remain curtailed before they are required to come back to normal energy levels. Each load offers a bid price and system dispatchers have a process in place to curtail these customers in the event of energy emergencies. The Load Curtailment program started in late 1998 and to date, these customers have been called upon 3 times to curtail in order to help maintain system security.

Demand Opportunity Service

When loads connect to the transmission system they can contract the capacity they require as either firm or opportunity; some customers choose a bit of both. When a customer chooses Demand Opportunity Service, the tariff charge is less than the firm service and comes with requirements where the energy being consumed at the opportunity service rate can be curtailed for emergency reasons such as local area voltage violations or transmission overloads or operating reserve shortfalls. It should be noted that the TA does not build any additional or new transmission facilities to serve DOS load, rather DOS can be viewed as taking advantage of available transmission capacity at that particular location in the Alberta system. The TA has 3 options for Demand Opportunity Service (DOS):

Option 1. Demand Opportunity Service Recallable in 7 Minutes ($3/MWh per metered energy)

Option 2. Demand Opportunity Service Recallable in 1 Hour ($5/MWh per metered energy)

Option 3. Demand Opportunity Service Term ($20/MWh per metered energy)

The above tariffs are the costs customers pay for DOS service. The quicker the load can be curtailed from the grid the less the customers pay in tariff charges for energy consumed.

Supplemental Reserves

Loads in Alberta have historically (pre-deregulation) provided supplemental reserves but more as a backup during emergencies only. Today, with high load growth and tight energy supply more options to meet Contingency Reserve requirements are critical. Generators have traditionally provided the first line of system reserves and during periods of tight energy supply, the customer is competing to obtain energy from the generator, and entities such as the TA are competing to back off generators to obtain adequate unloaded capacity for system reserves. Competing for the same resource for either energy or reserves can cause prices for energy, reserves or both to escalate.

The TA has been successful and at procuring loads on monthly contracts to provide supplemental reserves. Up to 50% of system contingency reserves can be provided from loads or quick start generators. The TA has had portfolios where up to 30% of system contingency reserves have been provided from loads during normal system operation.

In 1998, Alberta experienced high system load, high pool prices and 100% of contingency reserves were dispatched as spinning reserve because every available generator was on-line. The system was not in a state of emergency but energy and reserve costs were very high. During those periods of time, if sufficient load would have been procured as supplemental reserves, over 200 MW of generation capacity could have been returned to the energy market which would have had significant downward pressure on energy prices and reserve costs that are indexed to energy prices.

59.5 Hz Load Tripping

Up until 1973, Alberta operated as an electrical island separated from the WSCC. In 1973 a small 138kV intertie was placed into operation and in 1986 a 500kV intertie was

placed into operation and interconnected Alberta to BC and the WSCC. The Alberta-BC intertie experiences 3 pole trips due to lightning or high winds that develop in the mountain pass area of the Alberta - BC 500kV corridors. Should Alberta be importing energy prior to these 3 pole trips, underfrequency conditions will occur. Alberta still separates from BC up to 4 times per year. During the TA's tenure the import level for the 500 kV tie has been increased from 400 MW to 800 MW.
TA policy is to prevent unplanned loss of load due to Underfrequency Load Shedding as a result of an Alberta - BC separation during high import conditions. The line of defense to mitigate firm Underfrequency Load Shedding is:

1. Governor response from Spinning Reserve and Regulating Reserve generators.
2. Loads that will automatically shed at 59.5 Hz with no intentional time delay.
3. Generators that automatically fast ramp at 59.5 Hz (typically 30-second response).

Alberta typically has 100 MW of load armed to operate at 59.5 Hz.

Interruptible Load RAS (ILRAS)

As described in the 59.5 Hz Load Tripping section, Alberta has been known to separate from BC during import conditions. When imports on the Alberta - BC intertie start to exceed 400 MW and get as high as 800 MW, then the line of defense described above is insufficient to arrest frequency decline to prevent Underfrequency Load Shedding.
The TA has an Interruptible Load RAS or ILRAS program as it is referred to in Alberta. These are loads that will shed within 8 cycles of detection of the Alberta-BC intertie opening 3 pole when imports are greater than 400 MW. The TA has policies that prescribe the volumes of ILRAS required at various system load levels and various schedules for import conditions.
During an Alberta - BC separation at heavy import, ILRAS will operate near instantaneously. It is also expected frequency will decline (at a slower rate) and cause the 59.5Hz Load Tripping to occur as well. An Alberta-BC separation trip at 800 MW import would cause over 300 MW of load to be curtailed as a result of both the ILRAS and 59.5 Hz Load Tripping schemes to operate.

Summary:

Since 1998,

- over 400 MW of loads have participated in the various programs for procurement of Load for grid security.

Is it worth the effort and cost since 1998?

- Load Curtailment program 'kept the lights on' 3 times.
- 59.5 Hz Load Tripping has operated over 6 times where Alberta-BC imports were greater than 300 MW.
- ILRAS has operated 2 times where Alberta-BC imports were greater than 400 MW.

The Future.

EAL will be continuing to look at loads for supplemental frequency regulation. EAL is in the final stages of establishing an Ancillary Service Market for Operating Reserves where loads will have more opportunity to participate in either active or standby reserves. EAL will continue to explore innovative ways to procure reserves in order to ensure continued system reliability and put downward pressure on ancillary services costs.

Biography:

John Kehler (M98) studied Electronics Engineering at the Southern Alberta Institute of Technology and graduated in 1976. John started with TransAlta Utilities in 1976 and worked in technical groups that tested, tuned and repaired generator control systems. In 1987 John joined an engineering team to work with dynamic behavior of the Alberta electric system. During this period John developed simple and practical ways to describe power system behavior.

When the Alberta electric system de-regulated in 1996, John assisted various groups in Alberta to establish costs and implement contracts for ancillary services. In 1997, John led a team to performance test and model validate 29 TransAlta generators as required by the Western System Coordinating Council (WSCC).

In 1998, John joined ESBI Alberta Ltd. as a Technical Specialist. ESBI Alberta Ltd. is the first independent Transmission Administrator for the Alberta electric system. John actively participates on the WSCC Model Validation Work Group, WSCC Performance Validation Task Force, WSCC Frequency Regulation Task Force, and the WSCC Disturbance and Performance Monitoring Task Force.

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